

New species records of systellognathan stoneflies (Plecoptera: Systellognatha) for the fauna of the Korean Peninsula*

D. MURÁNYI¹, J.M. HWANG², M.J. JEON³ & H.Y. SEO³

¹Dávid Murányi, Department of Civil and Environmental Engineering, Ehime University, Bunkyo-cho 3, Matsuyama, 790-8577 Japan, and Department of Zoology, Hungarian Natural History Museum, H-1088 Budapest, Baross u. 13, Hungary. E-mail: muranyi@cee.ehime-u.ac.jp, muranyi@zool.nhmus.hu

²Jeong Mi Hwang, Korean Entomological Institute, Korea University, Anam-dong, Seongbuk-gu, Seoul 136-701, Republic of Korea. E-mail: msmay74@korea.ac.kr

³Mi Jeong Jeon, Hong Yul Seo, Animal Research Division, National Institute of Biological Resources, Gyoongseo-dong, Seo-gu, Incheon 404-708, Republic of Korea. E-mails: jeonmj@korea.kr, sysseo@korea.kr

Abstract. Three species of stoneflies are reported for the first time from the Korean Peninsula: *Pictetiella asiatica* Zwick & Levanidova, 1971, *Xanthoneuria unimaculata* (Zhiltzova, 1979) and a new species of the genus *Sweltsa* Ricker, 1943. The widespread temperate Asian species, *P. asiatica*, represents the first record of the Transpacific genus *Pictetiella* Illies, 1966 from Korea. *Xanthoneuria unimaculata* confirms the presence of *Xanthoneuria* Uchida, 2011 in Korea. This genus was hitherto known only from Japan and the Russian Far East with a dubious record from Korea. The female of *Sweltsa* sp. is formally described but not named because male remained unknown. All the specimens were collected in North Korea by colleagues from the Hungarian Natural History Museum during the 1970's and 1980's. New Korean records of further ten species are also enumerated, with notes about some doubtful records. Distribution area of the genera *Pictetiella* and *Xanthoneuria* are detailed and depicted on maps.

Keywords. Aquatic insects, *Pictetiella asiatica*, *Xanthoneuria unimaculata*, *Sweltsa* sp., distribution, North Korea

INTRODUCTION

Despite that the first Korean stonefly was reported relatively early from the Yalu River (Banks 1920), the Korean Plecoptera fauna was essentially unknown until the seventies (Zwick 1973a, 1973b). The fauna remained poorly known until the 1990s when intensive research was launched (Kim *et al.* 1998). Today, the Korean stoneflies fauna is relatively well known, with 77 species reported however, nearly one third was published only during the last five years (Murányi & Park 2011, Murányi *et al.* 2014, 2015, Stark 2010, Zwick 2010, Zwick & Baumann 2011). Unfortunately, our knowledge on the two Korean countries is very unbalanced, as 61 of the 77 species are known from South Korea (Murányi & Park 2011, Zwick & Baumann 2011) while only 34 species is registered for North Korea (Ham 2008, Murányi *et al.* 2014, 2015).

Between 1970 and 1994, colleagues from the Hungarian Natural History Museum had the opportunity to take 16 collecting expeditions to North Korea (Mahunka & Steinmann 1971, Méssáros & Zombori 1995). These efforts yielded some Plecoptera, but this material was only partially studied (Murányi *et al.* 2014, 2015, Stark & Sivec 2008b, Zwick 1973b). Here, we report on the Systellognathan genera *Xanthoneuria* Uchida, 2011 (in: Uchida *et al.* 2011), *Pictetiella* Illies, 1966 and *Sweltsa* Ricker, 1943 from the collection, including three species (*P. asiatica* Zwick & Levanidova, 1971; *X. unimaculata* (Zhiltzova, 1979) and a new species of the genus *Sweltsa* which represent new records for the Korean peninsula. Consequently, the number of stoneflies recorded from Korea is raised to 80. However, occurrence of some species reported from North Korea are questionable. We also discuss these doubts, and present distribution maps of the genera *Pictetiella* and *Xanthoneuria*.

MATERIAL AND METHODS

Specimens were stored dry in the Collection of Smaller Insect Orders, Department of Zoology, Hungarian Natural History Museum, Budapest, Hungary (HNHM). They were relaxed and transferred to vials with 70% ethanol, their terminalia were cleared in KOH. The material studied are deposited in the HNHM and in the National Institute of Biological Resources, Incheon, Republic of Korea (NIBR).

Epiproct and aedeagus were everted using the cold maceration technique of Zwick (1983). Illustrations were made with the aid of a drawing tube applied on a Nikon SMZ800 microscope. Terminology mainly follows Li *et al.* (2014), Teslenko & Minakawa (1999), Uchida *et al.* (2011) and Zwick & Weinzierl (1995).

Distributional data were compiled from literature data from various sources referenced in Plecoptera Species File (PSF) (DeWalt *et al.* 2015), but mainly from Teslenko & Zhiltzova (2009) and Uchida (1990).

RESULTS AND DISCUSSION

Perlidae

Xanthoneuria Uchida, 2011

Xanthoneuria Uchida, 2011: Uchida *et al.* 2011: 65. (original description on the basis of male, female and larva, by four species included); DeWalt *et al.* 2015, (catalog). *Japoneuria* Uchida, 1990: Uchida 1990: 123. (manuscript name).

Type species. *Acroneuria fulva* Klapálek, 1907, by original designation. Further species included: *Xanthoneuria bolivari* (Klapálek, 1907); *X. jouklii* (Klapálek, 1907), *X. unimaculata* (Zhiltzova, 1981).

This recently described genus contains three species restricted to Japan, and a coastal mainland species known from the Russian Far East and North Korea (Fig. 11).

Xanthoneuria unimaculata (Zhiltzova, 1981)

(Figures 1–3)

Xanthoneuria unimaculata (Zhiltzova, 1981): Uchida *et al.* 2011: 65. (comb. n.), DeWalt *et al.* 2015, (catalog). *Acroneuria unimaculata* Zhiltzova, 1981: 5. (original description of male and female); Zhiltzova 1995: 14. (type catalogue of RAS specimens). *Acroneuria unimaculata* Zhiltzova, 1979: Teslenko & Zhiltzova 2009: 54. (monograph, with mistaken date). *Japoneuria unimaculata* (Zhiltzova, 1981): Uchida 1990: 123. (manuscript name, comb. n.).

Type locality. Russia, Primorsky Krai, Komisarova River, Barabash Settlement, Pogranichny Raion (holotype), “Kedrovaya Pad” Reserve (paratypes).

Material examined. North Korea. North Pyongan Province, Hyangsan-gun, Myohyang Mts, at light on the balcony and garden of Hotel Myohyang-san (locality No. 793), 150 m, N40°00' E126°15', 14.vii.1982, leg. László Forró, László Ronkay: 1♀; North Pyongan province, Hyangsan-gun, Myohyang Mts, singled in the valley below Hwajangam (locality No. 816), 300 m, N40°00' E126°16', 17.vii.1982, leg. László Forró, László Ronkay: 1♀; North Pyongan Province, Hyangsan-gun, Myohyang Mts, at light on the balcony and garden of Hotel Myohyang-san (locality No. 829), 150 m, N40°00' E126°15', 18.vii.1982, leg. László Forró, László Ronkay: 1♂.

Distribution and ecology. The species was described from the southern part of Russian Far East, and hitherto had no concrete data from elsewhere (Teslenko 2012). Uchida *et al.* (2011) reported it also from Korea, but without any detailed locality. Probably, they referred to the data of *X. jouklii* from the Baekdu Mts (Kim *et al.* 1993), see below. The present specimens are all from the lower regions of Myohyang Mountains, forming the western chain of the Changbai (Baekdu) range that separates the Korean Peninsula from the Asian continent (Figs. 11, 13). At locality No. 816 it was the only stonefly caught, while at the light trap (No. 793 and 829) it was caught together with other perlids: *Paragnetina flavotincta* (McLachlan, 1872), *Neoperla coreensis* Ra, Kim, Kang & Ham, 1994 and a paratype of *N. goguryeo* Murányi & Li, 2015 (in Murányi *et al.* 2015).

Remarks. The Korean specimens agree well with the original description (Figs. 1–3). The aedeagus bears no spines or hairs, contrary to the Japanese species (Uchida *et al.* 2011). It was not possible to evert because of the poor condition of the specimen, so lobes and shape remained unknown. Unfortunately, the two females had no eggs, so details of the egg also remained unknown.

Perlodidae

Pictetiella Illies, 1966

Pictetiella Illies, 1966: 374. (replacement name for *Pictetia* Banks, 1948 non *Pictetia* Uhlig, 1882 (Mollusca) nec. *Pictetia* Brongniart, 1885 (Insecta); by monotypy, catalog); Zwick 1973: 237. (catalog), Stewart & Stark 2002: 434. (monograph); DeWalt *et al.* 2015, (catalog). *Pictetia* Banks, 1948: 281. (original description on the basis of imago somatic features, by monotypy). *Isogenus* (*Pictetia*) Banks, 1948: Ricker 1952: 120. (comb. n., description of male and larva, complementary description of female).

Type species. *Perla expansa* Banks, 1920 inherited from the replaced name by monotypy. Further species included: *Pictetiella asiatica* Zwick & Levanidova, 1971 (in Zwick *et al.* 1971), *P. lechleitneri* Stark & Kondratieff, 2004, *P. zwicki* Zhiltzova, 1976 (in Levanidova & Zhiltzova 1976).

This Transpacific genus contains two western Nearctic and two East Palaearctic species. Despite its wide distribution in the Asian part of Russia, the genus is hitherto unknown from China and Japan (Fig. 12).

Pictetiella asiatica Zwick & Levanidova, 1971

(Figs. 4–8)

Pictetiella asiatica Zwick & Levanidova, 1971: Zwick *et al.* 1971: 853. (original description of male, female and larva), Zwick 1973: 238. (catalog), Zhiltzova & Zapekina-Dulkeit 1986: 183. (complementary description of the imago), Zhiltzova 1995: 7. (type catalogue of RAS specimens), Teslenko & Zhiltzova 2009: 32, 266. (monograph); Judson & Nelson, 2012: 44 (complementary description of male and female).

Type locality. Russia, Kamchatka Peninsula, Kirpichnaya River (Kamchatka River Basin), Mil'kovo settlement.

Material examined. North Korea. Ryanggang province, Samjiyōn-gun, Baekdu Mts, singled in mixed larch-birch forest along a road (locality No. 197), 1600 m, N41°50' E128°15', 25.viii.1971, leg. Sándor Horvatovich, Jenő Papp: 1♂; Ryanggang province, Samjiyōn-gun, Baekdu Mts, at light by a small lake behind Hotel Samjiyōn (locality No. 373), 1700 m, N41°50' E128°15', 18.vii.1977, leg. Olivér György Dely, Ágnes Dely-Draskovits: 1♂.

Distribution and ecology. The species has wide distribution in Russia, from the Altai ranges to Kamchatka, recently was also reported from northern Mongolia. The present specimens are from the Baekdu Mountains, the central and highest chains of the Changbai (Baekdu) ranges. These records constitutes the southernmost distribution of the species (Figs. 12–13). At locality No. 373 it was the only stonefly caught at the light trap, while at locality No. 197 it was singled together with an unassociable *Amphinemura* Ris, 1902 female and with a male of *Kamimuria zwicki* Stark & Sivec, 2008a. The latter species is new for the fauna of North Korea and slightly extends its known range, as hitherto it was only known from South Korea. Perlidae gen. spec. in Zwick (1973a) probably also refers to this species.

Remarks. The Korean specimens mostly agree with the original description, and Dr. Valentina A. Teslenko kindly verified their probable conspecificity with the Russian specimens. However, some slight differences are worth to note (Figs. 4–8): finger-like projection of the epiproct tip is longer, and the epiproct tip possesses stronger dorsal sclerotization on the Korean specimens, resembling more to the epiproct tip of the Nearctic *P. expansa* than those of *P. asiatica*.

Chloroperlidae

Sweltsa Ricker, 1943

Alloperla (*Sweltsa*) Ricker, 1943: 135. (original description on the basis of male, female and larva, by twelve species included).

Sweltsa Ricker, 1943; Illies 1966: 450. (stat. n. as a genus, catalog), Zwick 1973: 297. (catalog), Surdick 1985: 23. (revision), Stewart & Stark 2002: 280. (monograph), DeWalt et al. 2015, (catalog).

Type species. *Alloperla oregonensis* Frison, 1935, by original designation. Further species included: 48 valid species (according to PSF), among them the followings are from Asia: *Sweltsa abdominalis* (Okamoto, 1912); *S. assam* Zwick, 1971; *S. baiyunshana* Li, Yang & Yao, 2014; *S. colorata* Zhiltzova & Levanidova, 1978; *S. illiesi* Zhiltzova & Levanidova, 1978; *S. insularis* Zhiltzova, 1978 (in Zhiltzova & Levanidova, 1978); *S. kibunensis* (Kawai, 1967); *S. lepnevae* Zhiltzova, 1977; *S. longistyla* (Wu, 1938); *S. nikkoensis* (Okamoto, 1912); *S. recurvata* (Wu, 1938); *S. shikawae* (Okamoto, 1912); *S. wui* Stark & Sivec, 2009; *S. yunnan* Tierno de Figueroa & Fochetti, 2002; *S. zhiltzovae* Zwick, 2010.

This Transpacific genus contains 33 western Nearctic, 12 East Palaearctic and 3 Oriental species. Among the East Palaearctic species, four poorly known species are restricted to Japan, a further one is known from the Pacific isles Sachalin, Kunashir and Shikotan. Three species are known from Central China, while the remaining four known from the coastal regions: *S. zhiltzovae* is known only from South Korea (Zwick, 2010), *S. colorata* and *S. lepnevae* were reported from the Russian Primorsky Krai and South Korea (Kim et al. 1998, Teslenko & Zhiltzova 2009, Zwick 2010), while *S. illiesi* has a wider distribution ranging from the Amurskaya Oblast of Russia through the Primorsky Krai and North Korea to South Korea (Ham 2008, Teslenko & Zhiltzova 2009). *Sweltsa colorata*, *S. lepnevae* and a further new species are reported from North Korea herein.

Sweltsa colorata Zhiltzova & Levanidova, 1978

Sweltsa colorata Zhiltzova & Levanidova, 1978: 20. (original description of male, female and larva), Zhiltzova 1995: 15. (type catalogue of RAS specimens), Teslenko & Zhiltzova 2009: 83, 307. (monograph).

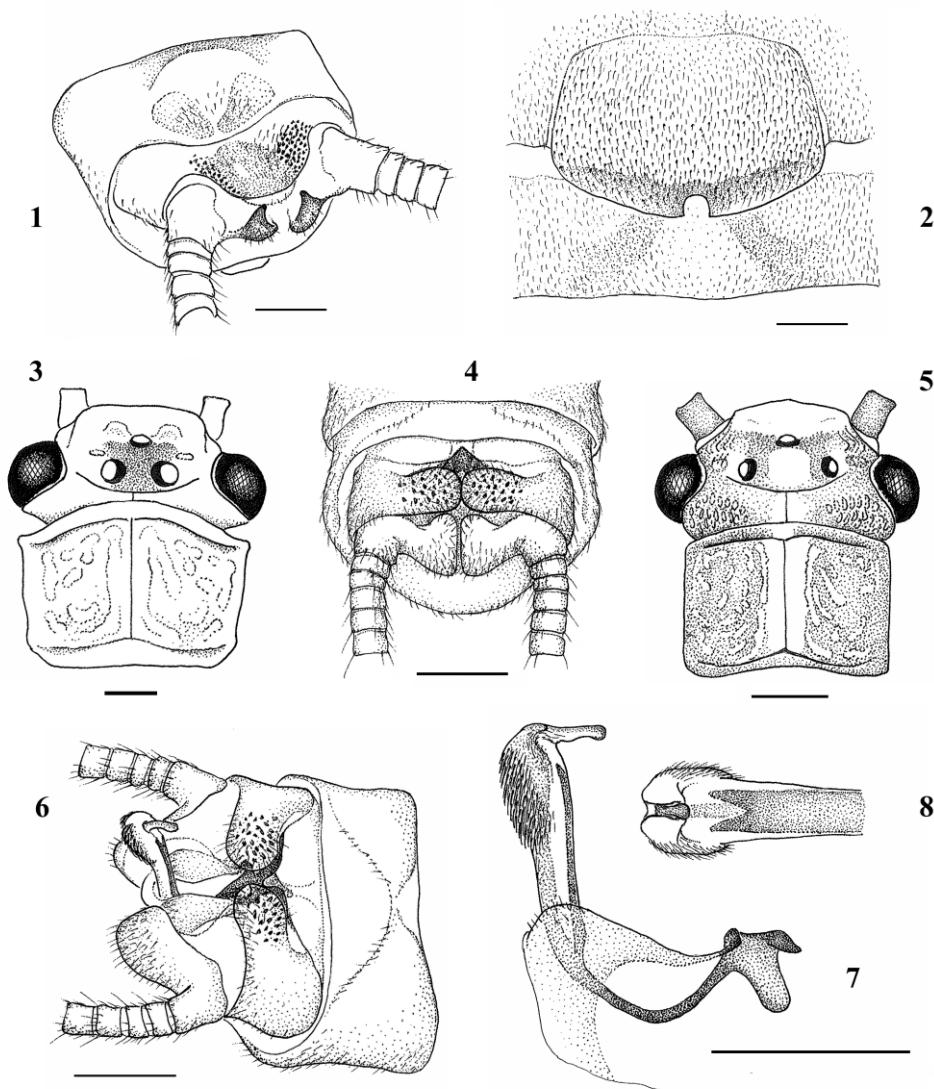
Sweltsa nikkoensis (Okamoto, 1912): Kim et al. 1998: 422. (synonymy of *S. colorata*, first Korean records; synonymy was disregarded by Teslenko & Zhiltzova 2009

and Zwick 2010), Ham 2008: 186. (complementary description of male and female).

Type locality. Russia, Primorsky Krai, Kedrovaya River, “Kedrovaya Pad” Reserve.

Material examined. North Korea. Pyongyang Capital City, Mt. Taesong, at light (locality No. 923), N39°04' E125°49', 17.v.1985, leg. András Vojnits, Lajos Zombori: 1♀; North Pyongan Province, Hyangsan-gun, Myohyang Mts, swept at Hyangsan Stream (locality No. 930), 500 m, N40°00' E126°15', 21.v.1985, leg. András Vojnits, Lajos Zombori: 1♀; North Pyongan province, Hyangsan-gun, Myohyang Mts, at light on the hotel balcony (locality No. 933), N40°00' E126°15', 21.v.1985, leg. András Vojnits, Lajos Zombori: 10♂ 1♀; North Pyongan province, Hyangsan-gun, Myohyang Mts, singled at Hyangsan Stream (locality No. 935), N40°00' E126°15', 22.v.1985, leg. András Vojnits, Lajos Zombori: 1♀; Kangwon Province, Kosöng-gun, Kumgang Mts, swept along footpath from Kumgang-mun Gate to Kuryong Falls (locality No. 951), N38° 40' E128° 10', 27.v.1985, leg. András Vojnits, Lajos Zombori: 2♀; Kangwon province, Kosöng-gun, Kumgang Mts, Oe-Kumgang rest house, swept in mixed forest (locality No. 952), N38°40' E128°15', 27.v.1985, leg. András Vojnits, Lajos Zombori: 1♂ 1♀; Kangwon Province, Kosöng-gun, Kumgang Mts, swept in forest at Kwinyon-am Rock (locality No. 956), N38°40' E128°15', 28.v.1985, leg. András Vojnits, Lajos Zombori: 1♂.

Distribution and ecology. The species was known from the Russian Primorie and numerous places in South Korea, but not yet reported from North Korea (Fig. 13). On Mt. Taesong it was collected together with *Perlomyia martynovi* (Zhiltzova, 1975) and *Amphinemura coreana* Zwick, 1973b. In the Myohyang Mts. it was the only stonefly collected at localities No. 933 and 935, while at Hyangsan Stream (locality No. 930) it was found together with *Perlomyia secunda* (Zapekina-Dulkeit, 1955) and *Sweltsa lepnevae*. In the Kumgang Mts. it was collected together with *Perlomyia* sp. at the Kuryong Falls (locality No. 951), with *A. coreana* at Oe-Kumgang (locality No. 952), while with a wider set of species in the forest at Kwinyon-am Rock (locality No.



Figures 1–8. *Xanthoneuria unimaculata* (Zhiltzova, 1981) from Myohyang Mts, North Korea (1–3) and *Pictetiella asiatica* Zwick & Levanidova, 1971 from Baekdu Mts, North Korea (4–8). 1 = male terminalia, dorso-caudal view; 2 = female sternite 8–9, ventral view; 3 = male head and pronotum, dorsal view; 4 = male terminalia before KOH treatment, dorsal view; 5 = male head and pronotum, dorsal view; 6 = male terminalia after KOH treatment, dorso-lateral view; 7 = everted male epiproct, lateral view; 8 = male epiproct tip, dorsal view. Scales 1 mm.

956): *Perlomyia kiritshenkoi* Zhiltzova, 1974, *P. mahunkai* (Zwick, 1973b), *P. smithae* Nelson & Hanson, 1973, *Perlomyia* sp. an unassociable *Nemoura* Latreille, 1796 female and three females of the same Chloroperlidae species that was published as *Triznaka* sp. by Zwick (1973b). Records of the above *Perlomyia* Banks, 1906 species were already enumerated by Murányi et al. (2014).

Sweltsa lepnevae Zhiltzova, 1977

(Figure 9)

Sweltsa lepnevae Zhiltzova, 1977: 24. (original description of male and female), Zhiltzova 1995: 16. (type catalogue of RAS specimens), Kim et al. 1998: 423. (first Korean records), Ham 2008: 186. (complementary description of male and female), Teslenko & Zhiltzova 2009: 83. (monograph).

Type locality. Russia, Primorsky Krai, Chuguevsky Raion, Bereozovy Creek, Pravaya Sokolovka River (Ussuri River Basin).

Material examined. North Korea. North Pyongan Province, Hyangsan-gun, Myohyang Mts, swept at Hyangsan Stream (locality No. 930), 500 m, N40°00' E126°15', 21.v.1985, leg. András Vojnits, Lajos Zombori: 1♀.

Distribution and ecology. The species was known from the Russian Primorsky Krai and South Korea, but not yet reported from North Korea (Fig. 13). In the Myohyang Mts. it was found together with *Perlomyia secunda* and *Sweltsa colorata*.

Remarks. Despite of a single female, the Korean specimen agrees well with the original description. Its head pattern is shown due for comparison with *Sweltsa* sp. (Fig. 9).

Sweltsa sp.

(Figure 10)

Material examined. North Korea. Pyongyang capital city, Pyongyang, singled in the garden of Hotel Pyongyang (locality No. 738), 25 m, N39°00' E125°45', 07.vii.1982, leg. László Forró, László Ronkay: 2♀; Ryanggang province, Samjiyön-gun, Baekdu Mts. Baekdu-san-milyong, singled at a brook in mixed larch-birch forest (locality No. 1353), 1500 m, N41°50' E128°15', 27.vi.1988, leg. Ottó Merkl, Győző Szél: 3♀.

Diagnosis. Female. Head flat and lacks any dark markings, pronotum with distinct, wide lateral stripes. Median stripe of the abdomen reach anterior margin of tergum IX.

Description. Medium sized species, macropterous. Forewing length: 9–10 mm. Ground colour white in alcohol (probably yellow in life), with dark brown markings on thorax and abdomen. Head wide and flat, completely white and lacks any dark markings (Fig. 10). Ocelli of usual size for the genus, compound eyes small. Antennae and palpi light brown. Pronotum white with

distinct, wide dark brown stripes on lateral margins; rugosities indistinct. Meso- and metanotum pale with dark ventrolateral bands, and distinct dorsal U-marks. Legs pale, tarsi brown; wings hyaline, venation yellowish. Pilosity generally short.

Female abdomen. Terga I–VIII with wide dark brown median stripe, markings anteriorly wider on each segments and narrowing on terga VII–VIII; terga IX with transverse dark marking only anteriomedially, tergum X completely white. Sterna all white; subgenital plate large and rounded, posterior margin linear or medially slightly emarginated. Paraproct simple, cerci pale, length usual for the genus.

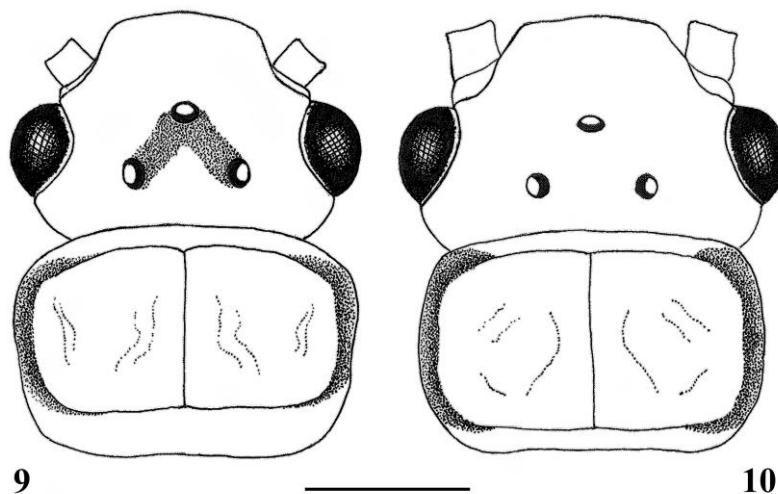
Distribution and ecology. The species was collected at relatively far and different localities in North Korea; from the highest chains of the Baekdu (Changbai) ranges in the North of the peninsula and from the western lowlands (Fig. 13). In Pyongyang it was collected together with a single *Paraleuctra* Hanson, 1941 female (probably *P. malaisei* Zwick, 2010), while in the Baekdu Mts. it was found together with three females of *Megarcys ochracea* (Klapálek, 1912).

Affinities. Among the known Asian *Sweltsa*, only this species and the Oriental *S. yunnan* Tierno de Figueroa & Fochetti, 2002 lacks completely the dark head pattern. *Sweltsa* sp. probably more close to *S. lepnevae*, as their general body colouration and shape of subgenital plate are mostly similar.

Doubtful records from North Korea

Several species that were reported from the Chinese border of North Korea (Yalu River, Wu (1938), and Baekdu Mts., Kim *et al.* (1993)) recently considered to be restricted to Japan. The specimens are not available, so their Korean/Chinese records are in need of confirmation.

Calineuria jezoensis (Okamoto, 1912). Kim *et al.* (1993) reported it from the Baekdu Mts., under the name *Acroneuria jezoensis* Okam. According to Uchida (1983, 1990), this species is restricted



Figures 9–10. *Sweltsa* Ricker, 1943 species from North Korea, female head and pronotum, dorsal view. 9 = *Sweltsa lepnevae* Zhiltzova, 1977 Myohyang Mts; 10 = *Sweltsa* sp. Baekdu Mts. Scale 1 mm.

to Japan, just like all the other Asian members of the Transpacific genus *Calineuria* Ricker, 1954.

Xanthoneuria jouklii (Klapálek, 1907). Kim *et al.* (1993) reported it from the Baekdu Mts., under the name *Acroneuria jouklii* Klap. Uchida *et al.* (2011) reported this species as restricted to Honshu. The record most probably refers to *X. unimaculata*, and its Korean mention in Uchida *et al.* (2011).

Paragnetina tinctipennis (McLachlan, 1875). Kim *et al.* (1993) reported it from the Baekdu Mts. According to Uchida (1990), this species is also restricted to Japan. The Korean record probably refers to *P. flavotincta*, widespread in the temperate zone of Asian mainland.

Stavsolus tenninus (Needham, 1905). Wu (1938) reported it from the Yalu River, under the name *Togoperla tennina* (Needham) (incorrectly indicated as a paratype). Sivec *et al.* (1988) transferred this species to *Stavsolus* Ricker, 1952, however, it was not included in the revision of the genus (Teslenko & Minakawa 1999) and its validity is not yet cleared. The Yalu River specimen probably belongs to *Stavsolus manchuricus* Terslenko, 1999 (in Teslenko & Minakawa, 1999), and *S. tenninus* should be a species restricted to Japan.

Tadamus scriptus (Klapálek, 1912). Kim *et al.* (1993) reported it from the Baekdu Mts., under the name *Isogenus scriptus* Klap. The genus *Tadamus* Ricker, 1952 is considered to be restricted to Japan, and *T. scriptus* may belongs to *Stavsolus* (DeWalt *et al.* 2015).

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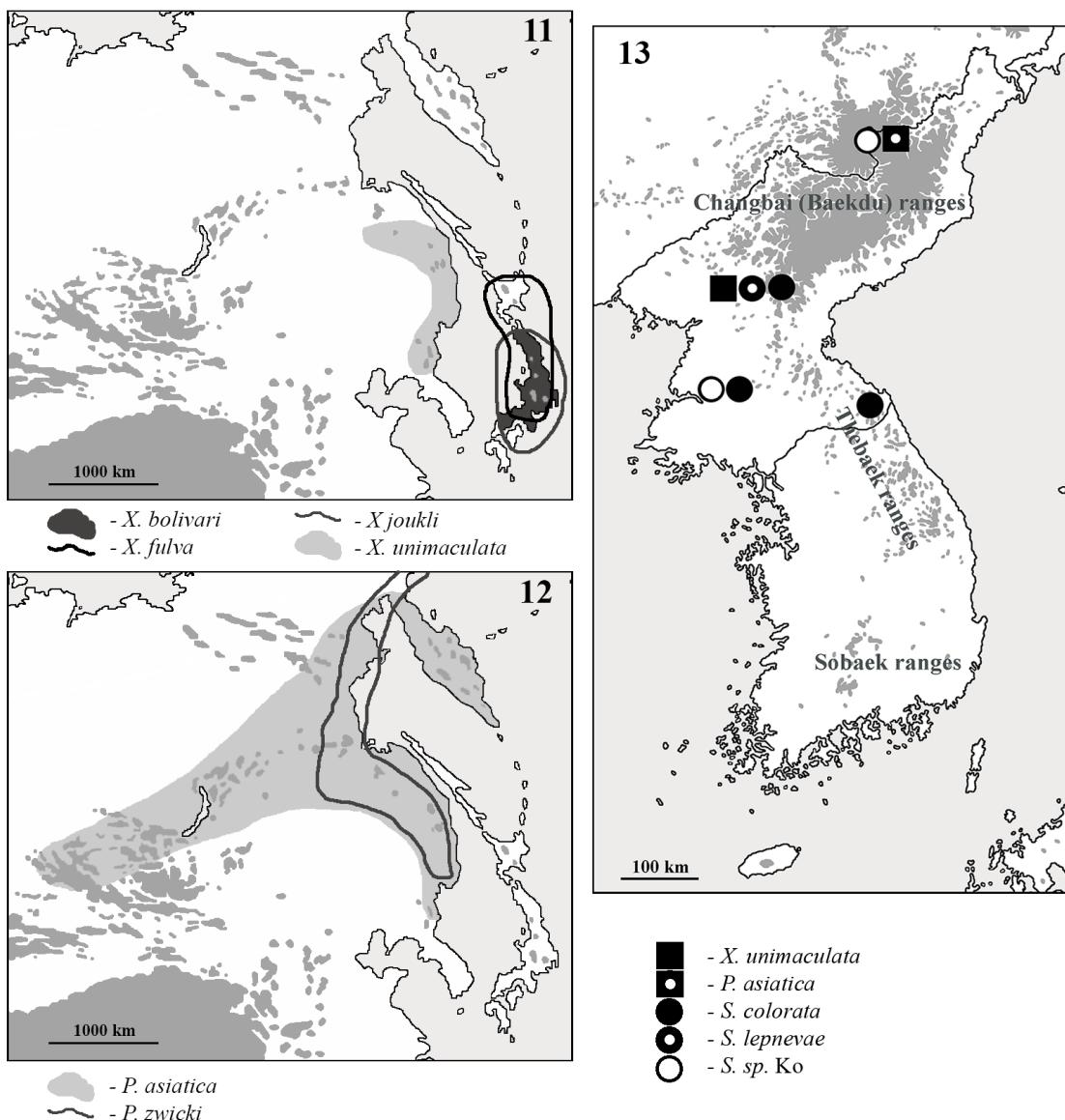
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Figures 11–13. Distribution of the genera *Xanthoneuria* Uchida, 2011 and *Pictetiella* Illies, 1966, and the North Korean localities reported in the present paper. 11 = distribution of the genus *Xanthoneuria* Uchida, 2011; 12 = Asian distribution of the genus *Pictetiella* Illies, 1966; 13 = North Korean localities reported in the present paper. Grey areas are above 2000 meters (Figs. 11–12) or 1000 meters (Fig. 13).

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